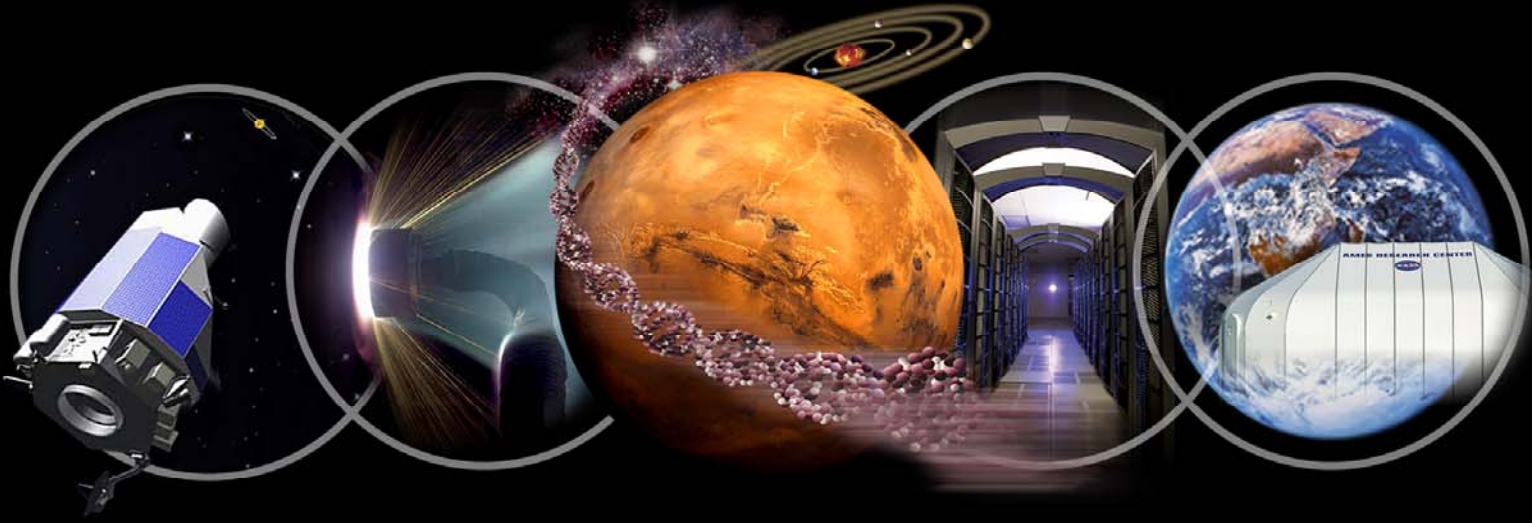


Discovery ➡ Innovation ➡ Solutions



High-End Computing

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Ames Exploration System Technology Partnerships Forum

July 22-23, 2004



Visibility ➡ Excellence ➡ Impact



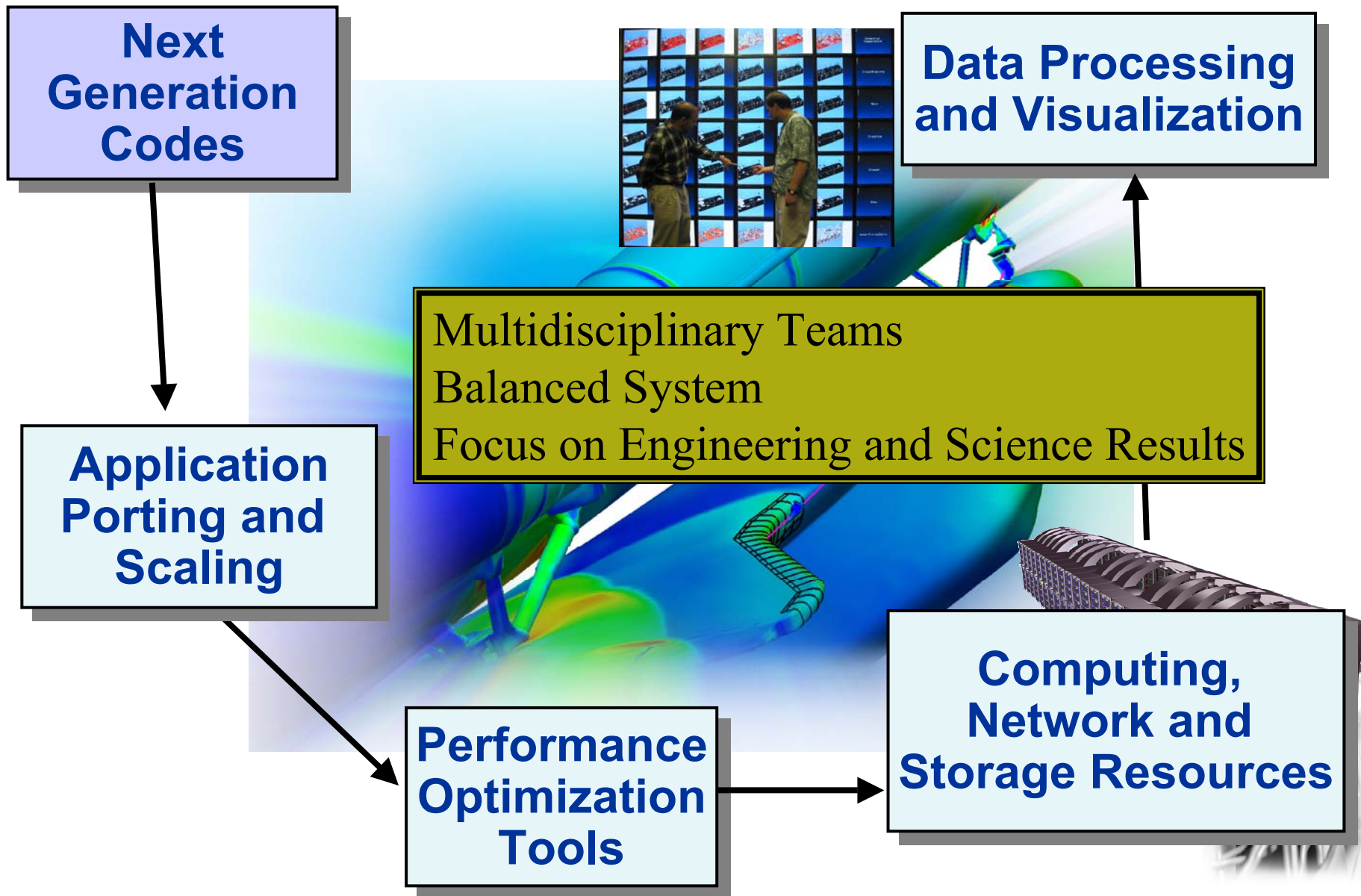


NASA Advanced Simulation (NAS) Program

- The NAS Program is sponsored by NASA Headquarters to provide a High-End Computing facility focused on Modeling and Simulation in support of all NASA's Missions
- Capabilities
 - Application Porting and Scaling
 - Performance optimization tools
 - Advanced Computing, networks and Storage
 - Data Processing, Analysis and Visualization
- Goal for this Forum
 - Introduce our capabilities to you
 - Offer them in support of the HR&T Extramural Call for Proposals



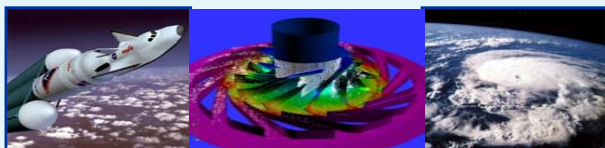
Capabilities



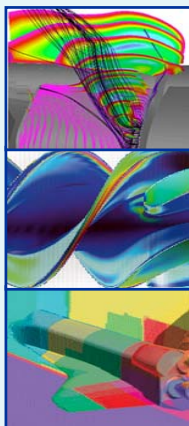


Capability: Application Porting and Scaling

Grand Challenges



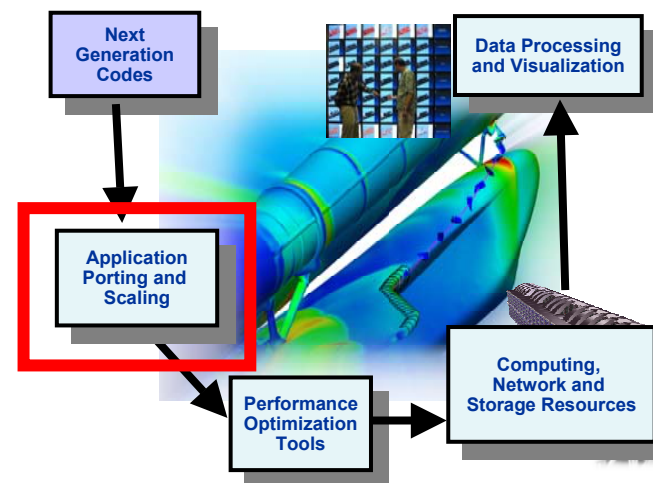
Next Generation Codes & Algorithms



OVERFLOW
NASA Software of year
Honorable mention
STS107

INS3D
NASA Software of year
Pump Analysis

CART3D
NASA Software of the Year
STS 107

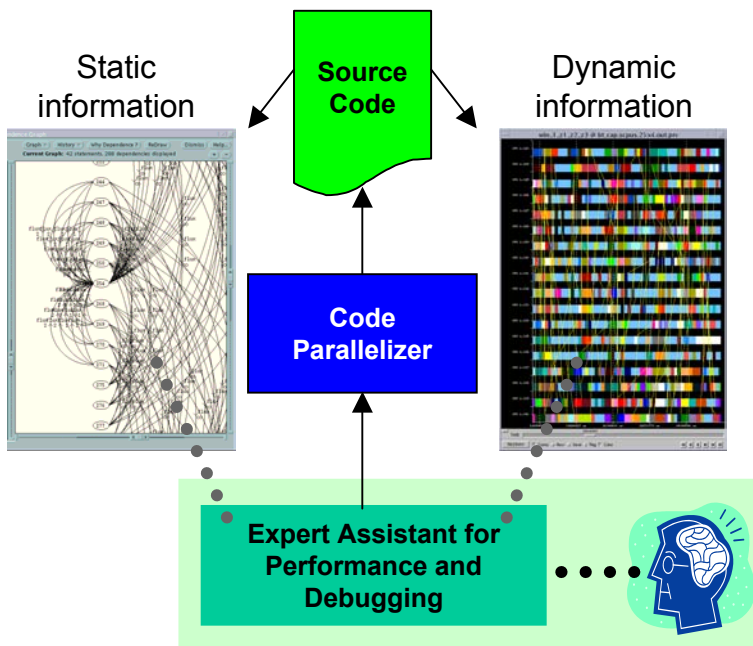
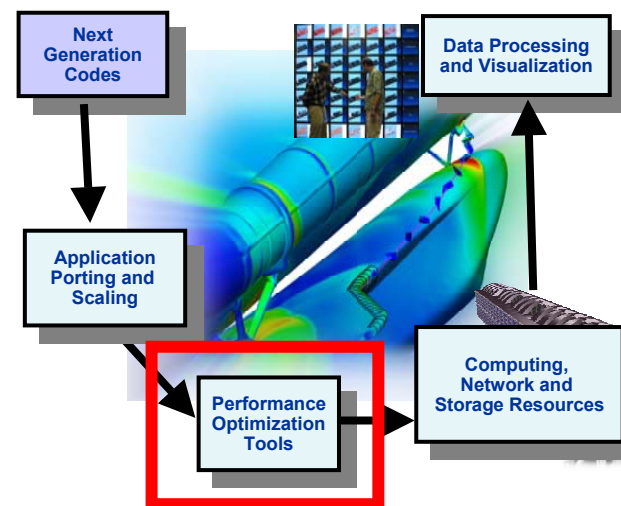
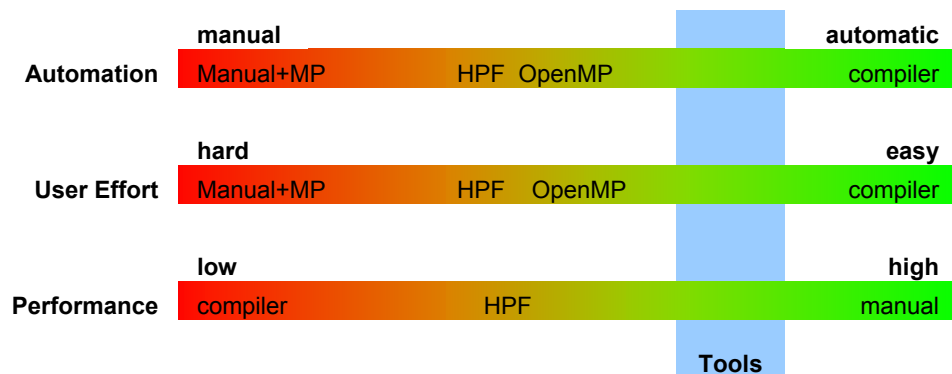


NAS has world renowned experts in:

- Model and simulation code porting
 - Rapidly ported critical RTF codes to new Altix platform
- Scaling codes
 - Scaled many RTF codes to 1024p
 - Scaling to 512p Altix - In Progress
- Code optimization.
 - Increased rate of return on an Earth Science code by more than **50x** over the previous year's effort



Capability: Performance Optimization Tools



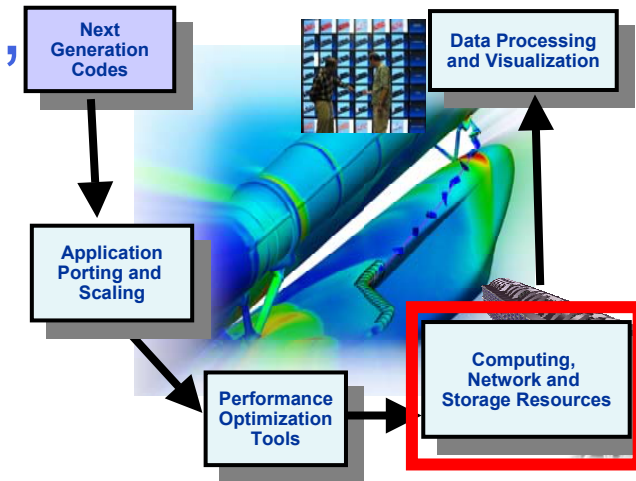
- Advanced systems for multi-level parallelization and tuning
- Automatic debugging of parallelized code using relative debugging techniques.
- An introspection framework for monitoring the execution, analyzing behavior and generating recommendations for complex codes.
- Coupling static analysis information with information about real-time performance.



Capability: Advanced Computing, Networks, and Storage



512-processor SGI Altix 3000

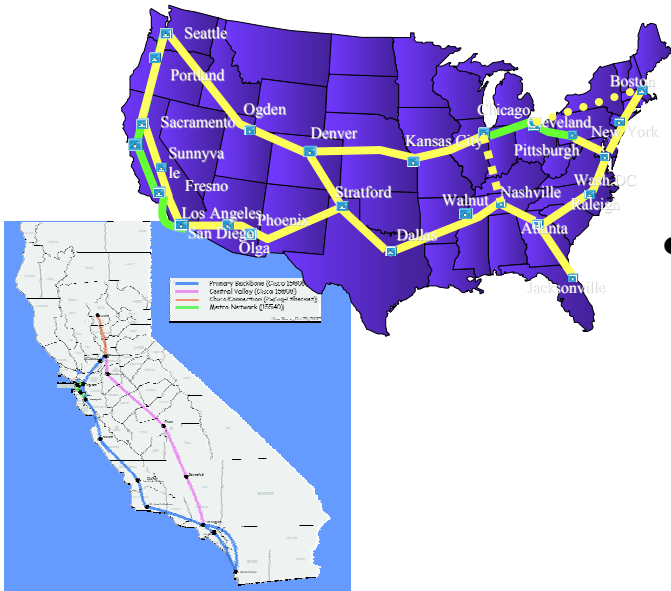


• Compute Capability and Capacity

- Lomax - 512 SGI Origin 3000 - .5 TFLOPs
- Kalpana - 512p SGI Altix - 3 TFLOPs
- Altix2 - 512p SGI Altix - 3 TFLOPs
- Cray-X1 - 16p - .192 TFLOPs

• Balanced Support Resources

- LAN & WAN Integration
 - Soon to provide 10Gb/s WAN access to NASA Centers, Industry and Universities via the National Lambda Rail and CENIC
- Near-Line Silo Data Storage - 6 PByte

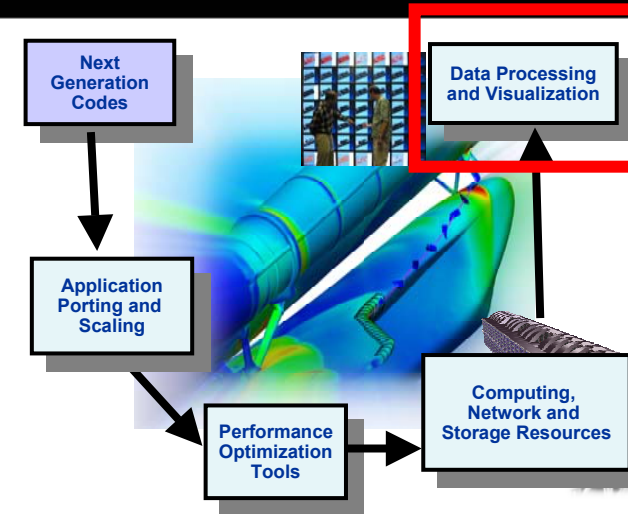




Capability: Data Processing and Visualization



QuickTime™ and a YUV420 codec decompressor are needed to see this picture.

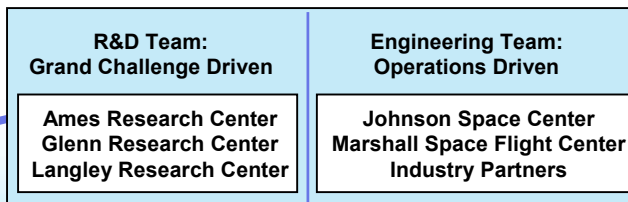


- Expert computer scientists in processing and visualizing large and complex data sets
- Innovative tools, such as the Hyperwall
- Skilled in standard visualization techniques (scalar, vector and tensor field)
- Have specialized methods for:
 - feature detection,
 - topological analysis
 - high-dimensional condition queries



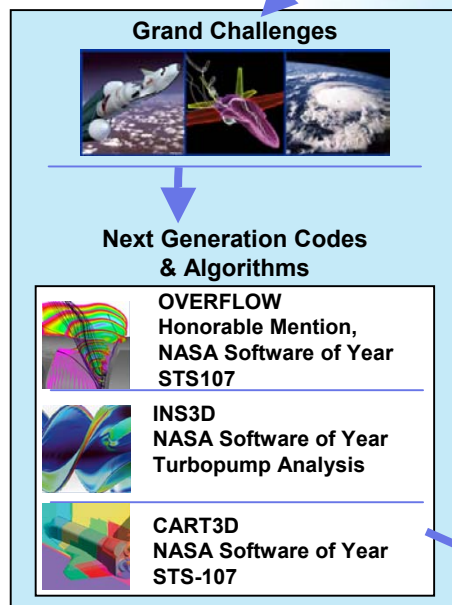
Columbia Accident Investigation Board (CAIB)

R&D and Operations teams joined to form integrated, interdisciplinary team to support CAIB in evaluation of launch and re-entry events



Bringing the investigation full circle, the team utilized advanced data analysis and visualization technologies to explore and understand the vast amount of data produced by this massive simulation effort

The team used state-of-the-art codes to meet the challenge of modeling a free object in the flow around an airframe, with automatic re-gridding at each time step



These codes have been honed by R&D experts in large-scale simulation, with their environment of programmer tools developed to minimize the effort of executing efficiently

**Modeling Environment
(experts and tools)**

- Compilers
- Scaling and Porting
- Parallelization Tools

Rapid, high-fidelity computational investigations may involve hundreds or thousands of large simulations and results datasets, but automated computation and data management tools are at the ready



Computation Management

- AeroDB
- ILab

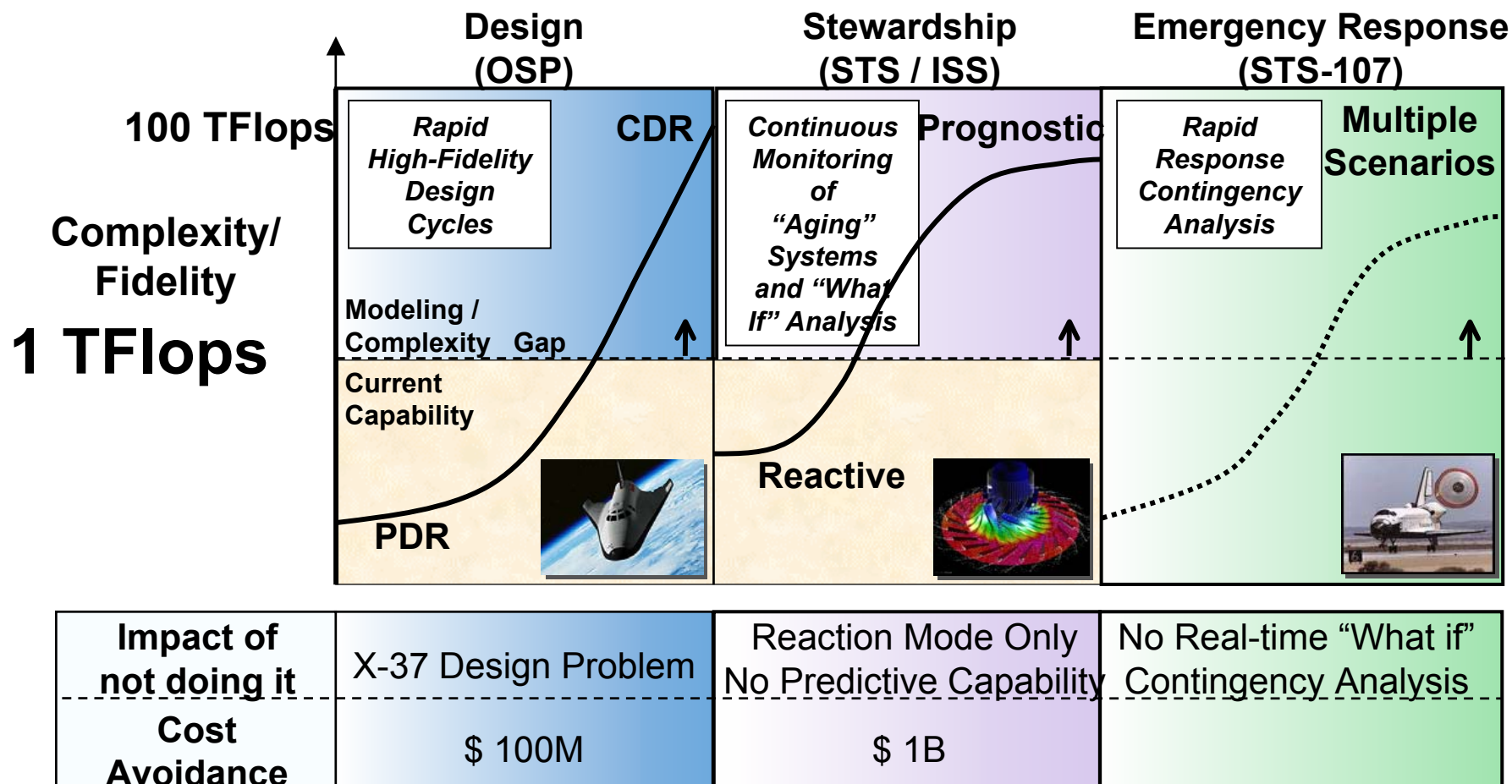
**Supercomputers,
Storage, & Networks**



The codes and tools were tuned to exploit advanced hardware (supercomputers, networks, and storage) that was developed for just such large, tightly-coupled computations, enabling rapid turnaround

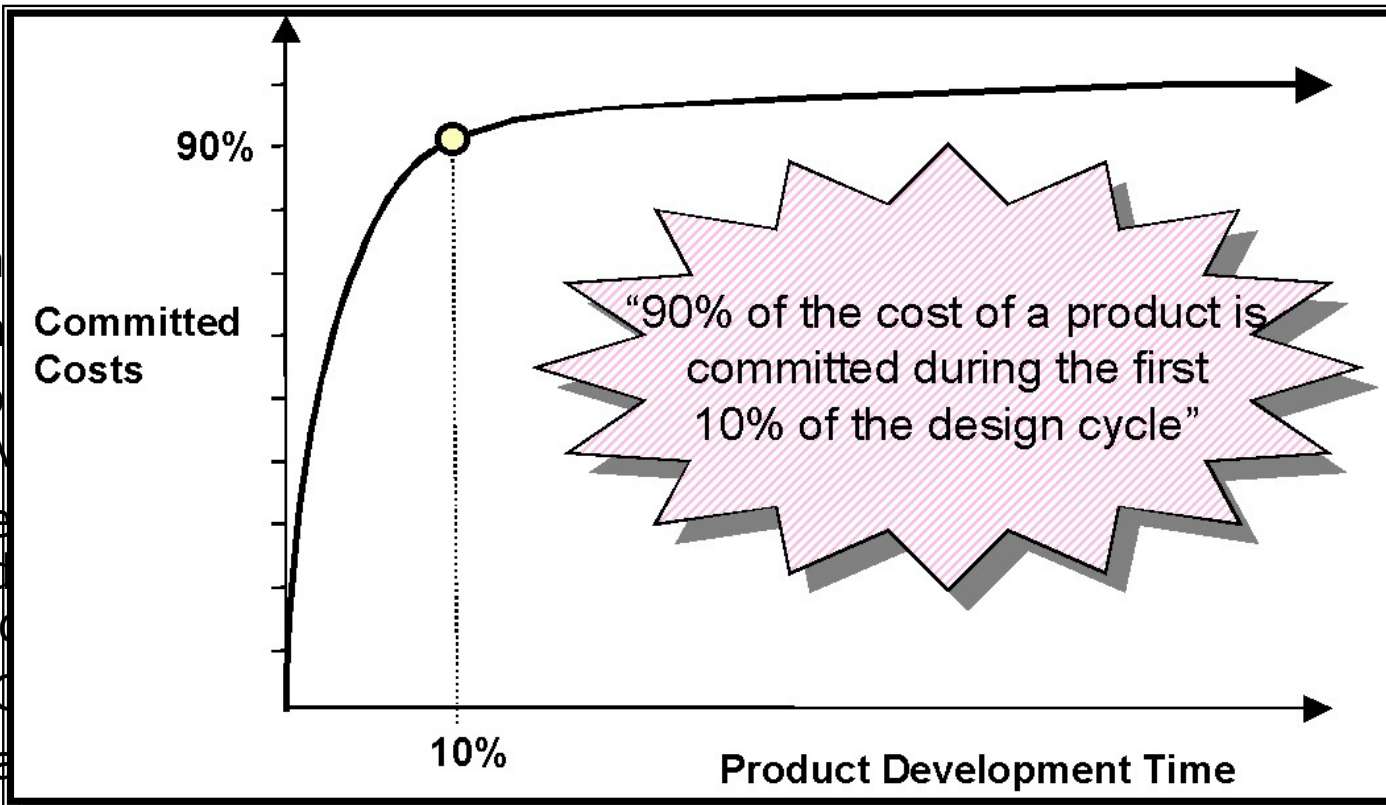


HEC Application Types for Exploration





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- High-Fidelity Modeling and Simulation used early in the design cycle, with large HEC, can reduce product cost
- Allows critical decisions made early to be based on accurate results from the simulation

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Access to NAS Resources

- The NASA Advanced Simulation Program and its resources are sponsored by NASA Headquarters
- They are available to The Exploration Systems Enterprise as well as other NASA Mission Directorates
- Access to this valuable resource is governed by NASA Enterprises
- If you have a challenging application, we encourage you to propose use of the NAS Program's resources
 - interested parties should contact the NAS Program POC (Dr. Walter Brooks, Walter.F.Brooks@nasa.gov) to inform him of your interest in using the facility